ENGINE INSTALLATION JIG

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BACKGROUND OF THE INVENTION

The invention relates to a device and method for aligning and installing inboard boat engines of varying sizes and configurations.

Inboard engines generally are large, powerful engines, used to drive larger marine vessels. Exclusively inboard engines are typically mounted inside the hull of the boat and mated to a propeller shaft passing through the bottom of the boat hull. Inboard engines can also be part of a marine stern drive. Marine stern drives include both an inboard engine and an outdrive. In a stern drive, the inboard engine is usually coupled to the outdrive, through the transom of the boat, via a drive shaft or the like.

Inboard engines may weigh thousands of pounds. Setting such a heavy engine within the engine bed of a boat commonly requires considerable manpower and the use of heavy machinery. Furthermore, the engine must be precisely vertically and horizontally aligned with both the hull and the propeller shaft of the boat. Since no boat is assuredly manufactured to exact specifications, precisely setting and aligning the engine in a boat is a time-consuming and cumbersome task.

Yet, the need for this precision cannot be ignored. An even slightly misaligned engine can significantly hinder the performance and comfort of a boat. A misaligned engine is often responsible for, among other things, excess vibration, reduced fuel economy and engine

efficiency,undue wear on the engine and transmission components and increased strain on the engine mounts and propeller shaft.

An inboard boat engine is conventionally mounted directly upon a pair of longitudinal stringers, extending through the interior hull of the boat, or on stringer brackets coupled to the stringers. Moreover, an inboard engine is necessarily mated to the propeller shaft through the bottom of the boat hull. However, before the engine is secured to the boat and mated to the propeller shaft, it must be precisely aligned. Once the engine is aligned to both the boat hull and the propeller shaft, it is installed. Holes matching the holes on the engine mounts are drilled in either the stringers or the stringer brackets through which the engine and the boat are joined.

The mount holes are frequently drilled and the propeller shaft aligned while the engine is already set in place. This procedure is problematic. Once the engine has been lowered into place, there is often inadequate clearance within the engine bed to drill the engine mount holes or even align the engine with the boat hull and the propeller shaft.

As a solution to this problem, inboard engine installers began marking the mount holes for subsequent drilling. However, this process requires the engine be removed, the holes drilled and the engine again lowered into place and secured. As explained above, removing and then precisely realigning the bulky engine adds substantial hours of labor to the engine installation. As a result, the manufacturing costs of the boat increase.

Consequently, it is desirable to minimize the adjustments to the engine after the engine has been installed. Accordingly, it is advantageous to precisely locate and drill the engine mount holes prior to dropping the engine into place within the engine bed. It is also desirable that the engine mount holes are precisely located so that the propeller shaft and the propeller drive of the engine are precisely aligned.

In the past, engine alignment and installation tools have been proposed for vertically and horizontally locating engine mounts. U.S. Patent No. 4,957,462, for example, discusses a tool and method for vertically and horizontally locating front engine mounts of a marine stern drive. However, the '462 patent does not address the need for locating the rear engine mounts of an inboard boat engine. In addition, the tool of the '462 patent is not adaptable for use with a broad range of inboard engine makes and models.

Other proposed designs of engine alignment and installation tools have attempted to expand the use of the tool to inboard engines of varying sizes and configurations. These designs may include interchangeable frame members and frame attachments. However, to date, the field of use of the existing engine alignment and installation tool designs is limited to those adapted for use with engines made by a single engine manufacturer.

There is therefore a need for an inboard engine installation jig and method that allows for simple and precise, three-dimensional engine mount and propeller shaft location and alignment, prior to the installation of the engine, and for a wide range of engine sizes and configurations, including engines of multiple manufacturers. There is also a need for an inboard engine installation jig that is capable of locating and aligning engine mounts on stringer brackets in inboard engine configurations where the engine is not directly mounted onto the stringers.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an engine installation jig allowing for simple, rapid and precise engine mount and propeller shaft location and alignment.

It is another object of the present invention to provide an engine installation jig capable of locating and aligning engine mounts for engine mounting on stringer brackets or directly on stringers of a marine vessel.

It is a further object of the present invention to provide an engine installation jig adaptable for use with inboard engine mounts, stringers, stringer brackets and propeller shafts of a wide variety of original equipment manufacturers.

It is to be understood that other objects and advantages of the present invention will be made apparent by the following description of the drawings according to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of the engine installation jig of the present invention.

FIG. **2** is a perspective view of the engine installation jig of the present invention mounted in position within an engine bed of a marine vessel.

FIG. **3** is a top perspective view of the engine installation jig of FIG. 1.

FIG. **4** is detailed perspective view of a convention rubber isolator for an inboard marine engine.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates, generally, to an engine installation jig **100**, used to aid in the location and alignment of engine mounts and the propeller shaft in a marine vessel equipped with an inboard engine.

During use, the engine installation jig **100** is set into the engine bed of the vessel, adjusted to match the installation criteria of the engine and the propeller shaft being used, then secured to

the stringers **10** either directly or via stringer brackets **20**. Once the engine installation jig **100** is secured, the engine mount holes may be marked for subsequent drilling or drilled while the jig **100** is still in place. If stringer brackets **20** are being used, the jig **100** may also used to locate, secure and then drill the stringer brackets **20** for subsequent coupling of the stringer brackets **20** to the stringers **10**.

Referring now to Figures 1-3, jig **100** includes a longitudinal frame member **200**, a first lateral crossbar frame member **300** and a second lateral crossbar frame member **400**. Each of the first and second lateral members **300** and **400** are attached to the longitudinal frame member **200**. Preferably, the first lateral member **300** is substantially perpendicular to and fixed to one end of the longitudinal member **200** and second lateral member **400** is substantially perpendicular and fixed to the other end of the longitudinal member **200**. It is to be understood, however, that one or both of the lateral members **300** and **400** may be interchangeable and /or removably attached to the longitudinal member **200** at any point along the length of the longitudinal member **200** to accommodate inboard engines of different sizes and configurations. Additionally, the lateral members **300** and **400** may be designed to slide along the length of the longitudinal member **200**. Furthermore, although shown in Figure 1 as fixed-length rigid members, each of the longitudinal member **200**, first lateral member **300**, and second lateral member **400** may be telescoping frame members, adjustable in length to accommodate engines of varying sizes.

The jig of the preferred embodiment may include gusset plates **500** used to reinforce the connections between the lateral members **300** and **400** and the longitudinal member **200**. The gusset plates **500** are shown in the preferred embodiment of Figure 1 as trapezoidal, but may of any shape suitable to the specific jig configuration.

Referring back to Figure 1, the jig **100** of the preferred embodiment also includes at least one end member, or drill fixture **600**, removably attached to each end **310** and **410** of lateral members **300** and **400** respectively. The drill fixtures **600** are attached to ends **310** and **410** of the lateral members **300** and **400** via corrosion resistant bolts, dowel pins, thumb screws, cotter pins, or the like. The drill fixtures **600** also are provided with at least one substantially flat surface **610** to rest flush upon the stringer brackets **20** or the stringers **10** of the marine vessel.

In the preferred embodiment, the surface **610** of the drill fixtures **600** includes a plurality of drill bushings **620**. The drill bushings **620** may be inserted and secured (by pressing or welding) into holes (not shown) formed in surface **610**. The drill bushings **620** may also be removable and interchangeable; screwed or snapped into the drill holes (not shown) formed in surface **610**. The drill bushings **620** are located to match the holes in the rubber isolators **70** associated with the engine mounts and brackets of the inboard engine, an example of which is shown in Figure 3. The drill bushings **620** are manufactured of a high strength material, such as hardened steel. The hardened material inhibits damage to the drill bushings **620** and the drill fixtures **600** while drilling through the drill bushings **620**. Nonetheless, it to be understood by one of ordinary skill in the art that the use of drill bushings **620** is optional. The drilling sites may be marked through the holes in the drill fixtures **600** and the drilling performed upon the removal of the jig **100** from the boat.

Each engine design may incorporate a differently contoured set of rubber isolators **70** and each rubber isolator **70** within a single engine design may be contoured differently. Likewise, stringer brackets **20** and sets of stringer brackets **20** may be variably contoured. Therefore, it is preferred that the contour of the surface **610** provide a visual representation of the rubber isolators **70** and the stringer brackets **20**, if used, to aid in the placement and orientation of the

drill fixtures upon the stringers **10** or stringer brackets **20**. Moreover, each drill fixture **600** may be independently contoured to match the size and even the shape of each rubber isolator **70** and/or stringer bracket **20** being used. Furthermore, as mentioned above, each drill fixture **600** may be removably attached to the ends **310** and **410** of the lateral members **300** and **400**, or interchangeable, to accommodate engine mounts of differing sizes and configurations.

The jig **100** of the preferred embodiment of Figure 1 also includes leveling devices **320**. It is preferred that the leveling devices **320** are each coupled to the drill fixtures **600**, as shown in Figure 1, and that the leveling devices **320** each contact the top surface of the stringers **10**. In an embodiment of the present invention where the engine is mounted on stringer brackets **20**, as shown in Figure 2, the leveling devices **320** extend parallel to the first lateral member **300**. In the embodiment of the present invention where the engine is mounted directly onto the stringers **10**, the leveling devices**320** would be coupled to the drill fixture **600** so that the leveling devices**320** extend in a direction perpendicular to the first lateral member **300**.

In one embodiment of the present invention, the leveling devices **320** may be utilized to hold the jig **100** in place while the engine mounts are marked and/or drilled. The leveling devices **320** may also be manipulated to adjust height of the jig **100** relative to the stringers **10** or the stringer brackets **20** as well as to level the jig **100** relative to the horizontal or the marine vessel. In the preferred embodiment of Figure 1, the leveling devices **320** are of a vice-type or screw-type. However, it is to be understood by one of ordinary skill in the art that any means of fine-tuning the height and level of the jig **100**, such as hydraulic jacks or bellows and shims may be used.

As discussed above, in the embodiment of the present invention, shown in Figure 2, the engine is mounted on stringer brackets **20** and not directly on the stringers **10**. In this

embodiment, the fist lateral member **300** includes a set of securing devices **330** and the second lateral member **400** includes a set of securing devices **430**. The securing devices **330** and **430** are preferably mounted on the bottom surfaces **305** and **405** proximate to the ends **310** and **410** of the first and second lateral members **300** and **400** respectively.

Once the jig **100** has been aligned with the stringers **10** using the leveling devices **320** and aligned with the stringer brackets **20** using the drill fixtures **600**, the securing devices **330** and **430** are actuated to clamp the stringer brackets **20** to the jig **100**. The stringer brackets **20** are then marked and/or drilled for subsequent attachment to the stringers **10**. The securing devices **330** and **430** are preferably toggle-type clamps. Yet, it is to be understood by one of ordinary skill in the art that other means, such as vice-grip pliers or suction force, may be used to secure the jig **100** to the stringer brackets **20** for marking and/or drilling.

In addition to aiding in the alignment of the engine with the stringers **10** of the marine vessel, the jig **100** of the present invention aids in the alignment of the engine with the propeller shaft **30** of the marine vessel as well. In a conventional inboard engine and propeller shaft connection, a propeller shaft mating flange **40** is used to mate the propeller shaft **30** with a corresponding mating member on the transmission or gear box of the inboard engine (not shown). The propeller shaft mating flange **40** typically includes several apertures for receiving connecting members, such as bolts, to secure the propeller shaft mating flange **40** to the transmission or the gearbox of the inboard engine.

In the preferred embodiment of the present invention, the engine is aligned with the propeller shaft **30** via a fixture head **248**. The fixture head **248** includes a pilot flange **250** used to simulate the propeller mating member on the transmission or gear box of the inboard engine (not shown). The pilot flange **250** mates to the propeller shaft mating flange **40** via mating

members **255** that extend out from the surface of the pilot flange **250**. The mating members **255** may be dowel pins or any members that suitably replicate the fastening members used to couple the propeller shaft mating flange **40** to the propeller mating member on the transmission or gearbox. Once the pilot flange **250** is mated with the propeller shaft mating flange **40**, a clamping device (not shown), such as a toggle clamp or vice-grip pliers, may be used to secure the connection while the jig **100** alignment is completed.

The fixture head **248** is coupled to the longitudinal member **200** of the jig **100**, as shown in Figure 1. However, different propeller shafts enter the boat hull at different angles and may also be of differing lengths. Consequently, the fixture head **248** may be interchangeable, whereby the fixture head **248** would be removably fastened to the longitudinal member **200** via bolts, dowel pins, thumb screws, cotter pins, or the like.

Additionally, the fixture head **248** may be slidably or pivotally coupled to the longitudinal member **200** of the jig **100**. Thus, the fixture head **248** may be then positioned and secured at any desirable point along the length of the longitudinal member **200** and at any desirable angle with respect to the longitudinal member **200**. The fixture head **248** may also include plural sets of mating members **255** with the fixture head **248** mounted to rotate so that the desirable mating members **255** may be rotated into position to mate with the propeller shaft mating flange **40**.The jig **100** of the preferred embodiment may also incorporate a lateral level sensor **360** and a longitudinal level sensor **260**. The horizontal level sensor **360** is preferably mounted on one of the lateral members **300** or **400** and enables the installer of the jig **100** to level the jig **100** and the stringer brackets **20**, if necessary, relative to the vessel or the true horizontal along the direction of the lateral members **300** and **400**. The longitudinal level sensor **260** is preferably mounted on the longitudinal member **200** and enables the installer of the jig **100** to set the angle of the jig

100 and the stringer brackets **20**, if necessary, to match to the angle of the propeller shaft coming through the bottom of the boat hull. The lateral and longitudinal level sensors **360** and **260** may be any of a number of commercially available level units of suitable size including digital-type level sensors.

The process of aligning the inboard engine for installation in the marine vessel according to the preferred embodiment of the present invention will now be described. Before installing the engine in the preferred embodiment of the present invention, the jig **100** is used to align both the engine mounts upon either the stringer brackets **20,** or the stringers **10,** and the propeller shaft **30**.During engine alignment, the jig **100** is first mated to the propeller shaft **30**. If the jig **100** does not have a fixed fixture head **248** attached thereto, the appropriate fixture head **248** is selected and attached to the jig **100**. If the fixture head **248** is adjustable, the fixture head **248** is set to the desired position and secured in place. The mating members **255** on the pilot flange **250** are then inserted into the corresponding apertures on the propeller shaft mating flange **40**. The pilot flange **250** is finally secured to the propeller shaft mating flange **40** via a clamping device (not shown).

Coupling the jig **100** first to the propeller shaft **30** and then to the stringer brackets **20** or stingers **10** according to the preferred embodiment has been described above. However, it is to be understood by one of ordinary skill in the art that the order of these steps may be reversed, as desired or needed, and first attach the jig **100** to the stringer brackets **20**, or stingers **10**, and then to the propeller shaft **30**.

At this point the connection of the jig **100** to the propeller shaft **30** suspends the jig **100** above the hull of the boat. The jig **100** and the fixture head **248** may then manipulated so that the leveling devices **320** rest upon the stringers **10**. The jig **100** is then positioned according to the

installation criteria. If the engine is to be mounted directly onto the stringers **10**, meaning no stringer brackets **20** will be used, the installation of the jig **100** is complete.

If stringer brackets **20** are being used, the stringer brackets **20** are positioned and coupled to the jig **100** via securing devices **330** and **430** for subsequent attachment to the stringers **10**. This process begins with the alignment of the stringer brackets **20**. The stringer brackets **20** are aligned along the fore and aft direction of the stringers **10** by maneuvering the stringer brackets **20** manually in the same longitudinal direction. As mentioned, the contour of the surfaces **610** of the drill fixtures **600** provide a reference template of the stringer brackets **20** to aid in the alignment of the stringer brackets **20**. The stringer brackets **20** are then positioned so that they lay flush against the stringers **10**. Once the desired positioned of the stringer brackets **20** is located, the stringer brackets **20** are coupled to the jig **100** via securing devices **330** and **430**. The installation of the jig **100** is now complete.

Now that the installation of the jig **100** is complete, the orientation of the jig **100** is adjusted according the installation criteria for the inboard engine being used. Level sensors **260** and **360** may be used to verify the orientation of the jig **100**. Leveling devices **320** may be used in concert to adjust the vertical position of the jig **100** relative to the stringers **10** or independently to adjust the angular position of the jig **100** relative to the boat. If further fine-tuning adjustments are desired, the angle and longitudinal position of the jig **100** may then be adjusted accordingly.

The jig **100** has now been installed and precisely aligned. The drill holes for attaching the stringer brackets **20** to the stringers **10** (if stringer brackets **20** are used) and the drill holes for attaching the engine mounts to the stringer brackets **20** or stringers **10** may now be drilled. The drill holes may be drilled with the jig **100** still in place or marked for subsequent drilling upon

removal of the jig **100**. Once the holes are drilled or marked, the jig **100** may be removed from the boat.

The jig **100** of the preferred embodiment is designed to reduce the time and effort needed to install a engine in a boat. Therefore it is preferred that the jig **100** is manufactured from lightweight material, such as aluminum. The preferred structural square tubing of the longitudinal member **200** and the lateral members **300** and **400** along with the lightweight material make the jig **100** stronger and more manageable during the engine alignment and installation process. One of ordinary skill in the art would appreciate that other materials such as alloys, PVC tubing, composites and even wood of assorted cross-sectional shapes may used to manufacture the jig **100** and its components. In addition, since the jig **100** may come into frequent contact with seawater, the jig **100** is preferably either coated or fabricated out of a non-corrosive material.

As described above, the jig **100** of the present invention is adaptable to match the specifications of inboard engine mounts (including the rubber isolators), stringers, stringer brackets and propeller shafts of any original equipment manufacturers. Therefore, the time required to install the inboard engine is significantly reduced while maintaining the precision required for optimum engine performance.